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(54) Shoulder endoprosthesis.

(57) A shoulder endoprosthesis is described, having a humeral part made up of a stalk that can be anchored in the humerus, a collar at the proximal end of the stalk, and a joint head in the shape of a segment of a sphere over the collar. The collar is designed to be essentially circular and has an open-cell or open-pore surface structure on at least sections of its under side to improve long-term fixation, and the joint head extends radially from its axis of rotation at least the periphery of the collar.

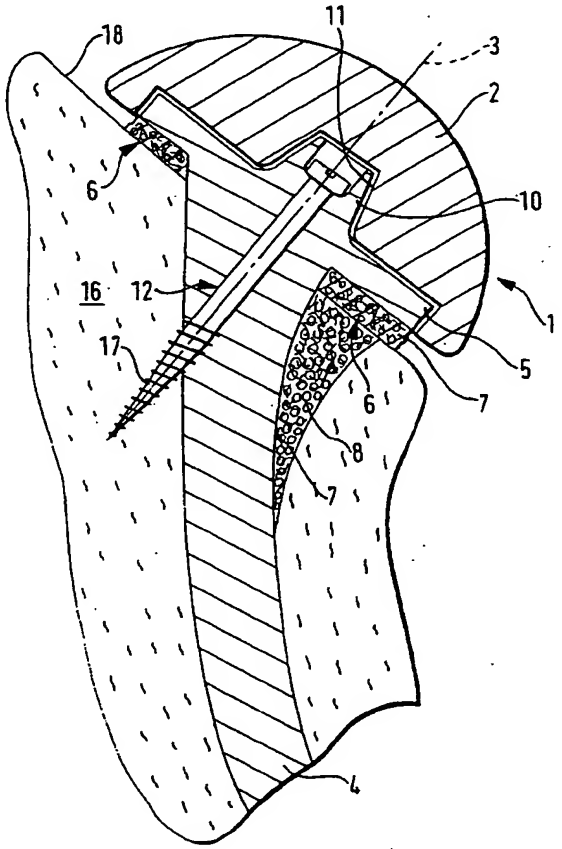

FIG.1

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The invention relates to a shoulder endoprosthesis with a humeral portion, comprising a stalk that can be anchored in the humerus, a collar at the proximal end of the stalk, and a joint head on the collar in the form of a segment of a sphere, and if necessary with a glenoid portion having a mounting element that can be anchored in the scapula, a plateau at one end of the mounting element, and a plastic inlay on the plateau to accept the joint head.

Such a shoulder endoprosthesis is known, for example, from European Patent Application 0 329 854. In this known prosthesis a collar, part of which projects radially beyond the collar and which provides positioning on the resected edge of the bone is placed at the proximal end of the stalk.

This known prosthesis has a disadvantage in that the height of the joint head section is relatively great in proportion to the very small space available, so that the physiological center of the joint is displaced. Also, the long-term anchoring of the shoulder endoprosthesis in the humerus or in the scapula is not always satisfactory, especially when no cement is used.

The object of this invention is, therefore, to mitigate the disadvantages of the prior art so as to assure reliable fixation of the prosthesis and reliable functioning of the prosthesis.

This object is attained according to the invention by a shoulder endoprosthesis of the type initially specified, such that the collar has essentially a circular contour and has on its lower side, at least in segments, an open-cell or open-pore surface structure, and such that the joint head extends radially from its axis of rotation at least to the periphery of the collar.

The special advantages of the invention are that the collar can, because of its essentially circular shape, adjoin the entire resected edge, and that the spongy bone can grow into it because of its open-cell or open-pore surface structure on the lower side. That substantially improves the long-term fixation of the humeral part in the humerus, correspondingly reducing the danger of a dislocation. Because the joint head extends radially from its axis of rotation at least to the periphery of the collar, the invention produces a joint head characterized simultaneously by a low overall height and a large joint area. That assures reliable functioning of the prosthesis. Furthermore, the physiological point of rotation of the joint is also retained because of the low height.

This object of the invention is further attained in a shoulder endoprosthesis of the type initially specified by a glenoid part, the plateau of which has an open-cell or open-pore surface structure, at least in sections, on the side toward the bone.

That provides improved anchoring of the glenoid part. Following surgical primary fixation, spongy bone tissue can grow into the cells or pores of the surface structure, yielding a particularly intimate joint between the bone and the prosthesis.

It is particularly desirable for the joint head to extend radially from its axis of rotation to the periphery of the collar, axially immediately adjoining the periphery of the collar. Thus the periphery of the collar, properly shaped, can form a spherical cavity along with the joint head, all of which is available as a joint surface. In this manner, the limited space available for the joint head is utilized optimally. The effective joint surface extends to space available for the joint head is utilized optimally. The effective joint surface extends to the resected edge of the humerus.

As an alternative to this, in another especially preferred embodiment of the invention, the joint head also extends axially beyond the periphery of the collar. In this embodiment, also, no significant spaces are produced between the resected edge and the joint head. The joint head extends past the collar axially and radially, and the edge of this section lies immediately adjacent to the resected edge of the humerus. This embodiment utilizes the space available in the shoulder region for the joint head especially well. The large joint area assures reliable functioning of the prosthesis.

It is particularly desirable for the joint head to be mounted removably on the collar, so that a suitable joint head for the patient can be selected during surgery, if there is a suitable supply of different sizes of joint heads. Tapered plug joints between the joint head and collar have proved advantageous. Tapered plug joints are self-limiting, so that they are particularly simple connections.

It has also proved advantageous to have the conical cavity on the underside of the joint head with the tapered plug on the collar, so as to keep the height of the humerus part as low as possible.

It is particularly preferable to place a coupling element between the joint head and the collar. The coupling element has an inner cone which can be placed on the tapered plug of the collar and an outer cone which can be placed in the conical cavity on the underside of the joint head. The principal advantages of this particularly preferred embodiment are that, given a proper supply during the surgery, it is possible to choose not only the size of the joint head but also the distance between the plateau and the joint head. It is preferable for the axes of rotation of the inner cone and the outer cone of the coupling element to be at a specified angle with each other. In this way, the antetorsional or retrotorsional angle of the joint head can be selected, and adjusted during the surgery, to meet the requirements of the patient.

It is particularly preferred for the humerus part of the shoulder endoprosthesis to contain at least two wings;

which branch off radially from the stalk, separated by about 90°, and which end at the lower side of the collar. It is desirable for the wings to be directed medially. An embodiment with four wings is also conceivable, with two of the wings directed dorsally and two medially. It is particularly preferred for the wings to have, at least in sections, an open-cell or open-pore surface structure. The wings can accept forces acting transversely to the humerus on the joint head, and improve the total fastening of the humeral part in the humerus. Growth of spongy bone material into the open-cell or open-pore surface structure of the wings gives a particularly intimate joint between the bone and the prosthesis.

It is particularly preferred to have a hole through the collar and the proximal segment of the stalk, through which a bone screw can be placed to anchor the humerus part in the humerus. In this case it is desirable for the axes of rotation of the joint head and the hole to coincide. That makes it possible for the surgeon to introduce a bone screw into the hole in the collar, projecting laterally to the stalk, which can be anchored in the spongy tissue of the humerus to achieve sufficient primary fixation of the humeral part in the humerus.

It is advantageous for the stalk to have an essentially circular cross section tapering toward its distal end so as to match the anatomic details of the humerus.

It is advantageous for the plateau of the glenoid part to be rotationally symmetric with a hole through it in the center for placing a bone screw to anchor the plateau in the scapula.

The fastening element of the glenoid part also contains a stalk that can be anchored in the spongy tissue of the scapula, with the hole through its center. That provides particularly good primary fixation of the glenoid part.

It is advantageous for the fastening element of the glenoid part to have at least one wing with open-cell or open-pore surface structure. The wing provides for better acceptance of the transverse forces, and promotes growth of the spongy tissue into the cells or pores of the surface structure.

It is particularly preferable for there to be a snap joint between the plateau and the end of the plastic. According to one preferred embodiment of the invention, the plateau has a peripheral flange which surrounds the edge of the inlay, whereby mutually corresponding projections or cavities, respectively, are provided on the inner side of the peripheral flange and on the outer edge of the inlay so as to provide for removably fastening the inlay into the plateau. That assures that the plastic inlay is securely fastened onto the plateau, and also provides the surgeon the possibility of selecting a plastic inlay to fit the joint head after the plateau is fastened into the scapula, and then fastening it to the plateau.

It is desirable for the plastic inlay to be thicker in the cranial region to reduce the danger of dislocation of the joint.

In the following, embodiments of the invention are described by means of the drawings. They show:

Figure 1. a cross-section of a humeral part of a shoulder endoprosthesis anchored in the humerus;
Figure 2. a cross-section through another embodiment of the humeral part;
Figure 3. a cross-section through the stalk and the wing of the humeral part;
Figure 4. a cross-section through a coupling element;
Figure 5. a cross-section through a glenoid part of the shoulder endoprosthesis;
Figure 6. a perspective view of a plastic inlay for the glenoid part according to Figure 4.

Figures 1 and 2 show a humeral part **1** of a shoulder endoprosthesis having a joint head **2** in the shape of a segment of a sphere, which is anchored in the humerus **16** with a stalk **4**.

Two wings **8**, 90° apart, branch off from the stalk **4** in the medial direction, tapering toward the outside. The wings **8** and the stalk **4** are also shown in cross-section in Figure 3. The wings **8** provide better transfer of transverse forces and have an open-cell or open-pore surface structure **7** into which the bone material can grow for better fixation to the bone. The radial extent of the wings **8** increases from distal to proximal, corresponding to the anatomic details of the human humerus **16**.

A collar **5**, designed as an essentially circular disk, is placed at the proximal end of the stalk **4**. The collar **5** lies with its distal underside **6** on the resected edge **18** of the humerus **16**. An open-cell or open-pore surface structure **7**, into which the spongy tissue can grow for better fixation of the humeral part **1** to the humerus **16**, is provided on the underside **6** of the collar **5**. There is a tapered plug **10** on the collar **5**, onto which the joint head **2** can be plugged with the corresponding conical cavity **11** on its distal underside. A hole **12** passes through the tapered plug **10**, the collar **5** and the stalk **4** to accept a bone screw **17**. The rotational axis of the hole coincides essentially with that of the tapered plug **10**. The through-hole **12** can be widened in the tapered plug **10** to accept the head of the bone screw **17**. The bone screw **17** is introduced into the through-hole **12** from above during the surgery, before the joint head **2** is set in place. It emerges from the lateral side of the stalk **4** and is screwed into the spongy tissue of the humerus **16**.

The joint head **2**, formed as a segment of a sphere, has a cavity corresponding to the collar **5** at its underside and projects both radially and axially beyond the collar **5** in the embodiment shown in Figure 1. Thus the surface of the joint head **2** extends nearly to the resected edge **18** of the humerus **16**.

In spite of the large joint area, the overall height of the humeral part **1** above the resected edge **18** is small, so that the physiological center of the joint is maintained.

The same advantages can also be attained with the embodiment shown in Figure 2, in which the joint head **2** extends radially from its axis of rotation to the periphery of the collar **5** and immediately adjoins the periphery of the collar **5**. The shape of the periphery of the collar **5** is matched to the surface of the joint head **2** and, together with the joint head, forms a spherical vault, all of which is available as joint surface.

By means of the tapered plug joint between the plateau **5** and the joint head **2** it is possible, during the surgery and after the stalk **4** has been mounted in the resected humerus **16**, to select a joint head **2** which appears to be of suitable size. Furthermore, a separate coupling element **13** can be placed between the joint head **2** and the plateau **5**, as shown in cross section in Figure 4. The coupling element **13** has an inner cone **14** and an outer cone **15**, fitting the tapered plug **10** and the conical cavity **11**, respectively. The axes of rotation **14a** and **15a** of the inner cone **14** and the outer cone **15**, respectively of the coupling element make a specified angle α with each other. If necessary the angle α can be 0°. By choice of a suitable coupling element it is possible to adjust not only the antetorsional and retrotorsional angles but also the distance between the plateau **5** and the joint head **2**.

Figure 5 shows a glenoid part **20** of the shoulder endoprosthesis in cross section. The glenoid part **20** has a metallic plateau **22** with a peripheral flange **21** which encloses the edge of an inlay **30**. In the embodiment shown, mutually corresponding projections **21a** and cavities **31a** are provided between the flange **21** and the plastic inlay **30** so that the plastic inlay can be removably fastened to the plateau **22**. That provides for secure fastening of the plastic inlay **30** onto the plateau **22**, and also makes it possible for the surgeon to use a plastic inlay **30** matching the selected joint head **2**.

As Figure 6 in particular shows, the thickness of the plastic inlay **30** increases toward the cranial region to prevent a cranial displacement of the joint head and dislocation of the joint.

A stalk **29** is placed at the underside of the plateau **22** for anchoring in the spongy tissue of the scapula. A hole **25** runs through the plateau **22** and the stalk **29**, through which a bone screw **27** passes in the direction of the scapular bone. An open-cell or open-pore surface structure **7** into which the bone material can grow is provided at the underside of the plateau **22** for added improvement of the fastening of the glenoid part **20** to the shoulder bone. For the same reason, there are wings **33** having open-cell or open-pore surface structure branching off perpendicularly from the plateau **22** on the side toward the bone. The wings **33** provide for better transfer of transverse forces, and at the same time they increase the surface into which the spongy bone material can grow.

Claims

1. Shoulder endoprosthesis having a humeral part comprising a stalk that can be anchored in the humerus, a collar at the proximal end of the stalk, and a joint head formed as a segment of a sphere on the collar, characterized by the fact that the collar (5) is designed as an essentially circular disk and has on its underside (6), at least in sections, an open-cell or open-pore surface structure (7), and that the joint head (2) extends radially from its axis of rotation (3) at least to the periphery of the collar (5).

2. Shoulder endoprosthesis according to Claim 1, characterized by the fact that the joint head (2) extends radially from its axis of rotation (3) to the periphery of the collar (5).

3. Shoulder endoprosthesis according to Claim 2, characterized by the fact that the periphery of the collar (5) is axially adjacent the joint head (2).

4. Shoulder endoprosthesis according to Claim 3, characterized by the fact that the periphery of the collar (5) is matched to the surface of the joint head (2) so that the joint head (2) and the collar (5) form a spherical vault.

5. Shoulder endoprosthesis according to Claim 1, characterized by the fact that the joint head (2) projects axially beyond the periphery of the collar (5).

6. Shoulder endoprosthesis according to one of the preceding claims, characterized by the fact that the joint head (2) is removably fastened to the collar (5).

7. Shoulder endoprosthesis according to one of the preceding claims, characterized by a tapered-plug connection (10, 11) between the joint head and the collar (5).

8. Shoulder endoprosthesis according to Claim 7, characterized by the fact that there is a conical cavity (11) on the underside of the joint head (2) and a tapered plug (10) on the collar (5).

9. Shoulder endoprosthesis according to one of the preceding claims, characterized by a coupling element (13) between the joint head (2) and the collar (15), having an inner cone (14) and an outer cone (15) so that the inner cone (14) can be coupled with the tapered plug (10) and the outer cone (15) can be coupled with the conical cavity (11).

10. Shoulder endoprosthesis according to one of the preceding claims, characterized by the fact that the rotational axis (3) of the joint head (2) is at a specified angle to the underside (6) of the collar (5).

11. Shoulder endoprosthesis according to Claim 9 or 10, characterized by the fact that the rotational axes of the inner cone (14) and the outer cone (15) of the coupling element (13) make a specified angle α with each other.

12. Shoulder endoprosthesis according to one of the preceding claims, characterized by the fact that there is on the underside of the joint head (2) a cavity matching the collar (5).

13. Shoulder endoprosthesis according to one of the preceding claims, characterized by at least two wings (8) branching radially from the stalk (4), which extend to the underside (6) of the collar (5).

14. Shoulder endoprosthesis according to Claim 13, characterized by the fact that the wings (8) have, at least in sections, an open-cell or open-pore surface structure (7).

15. Shoulder endoprosthesis according to one of the Claims 13 or 14, characterized by the fact that at least two wings (8) are directed medially.

16. Shoulder endoprosthesis according to one of the preceding claims, characterized by the fact that the stalk (2) tapers toward its distal end.

17. Shoulder endoprosthesis having a glenoid part with a mounting element that can be fastened in the scapula, a plateau at one end of the mounting element, and a plastic inlay (30) on the plateau to accept a joint head as claimed in one of the preceding claims, characterized by the fact that the plateau (22) has an open-cell or open-pore structure (7), at least in sections, on the side toward the bone.

18. Shoulder endoprosthesis according to Claim 26, characterized by the fact that the wing (33) has, at least in sections, an open-cell or open-pore surface structure (7).

19. Shoulder endoprosthesis according to one of the Claims 21 to 29, characterized by the fact that the plastic inlay (30) is thicker in the cranial region.

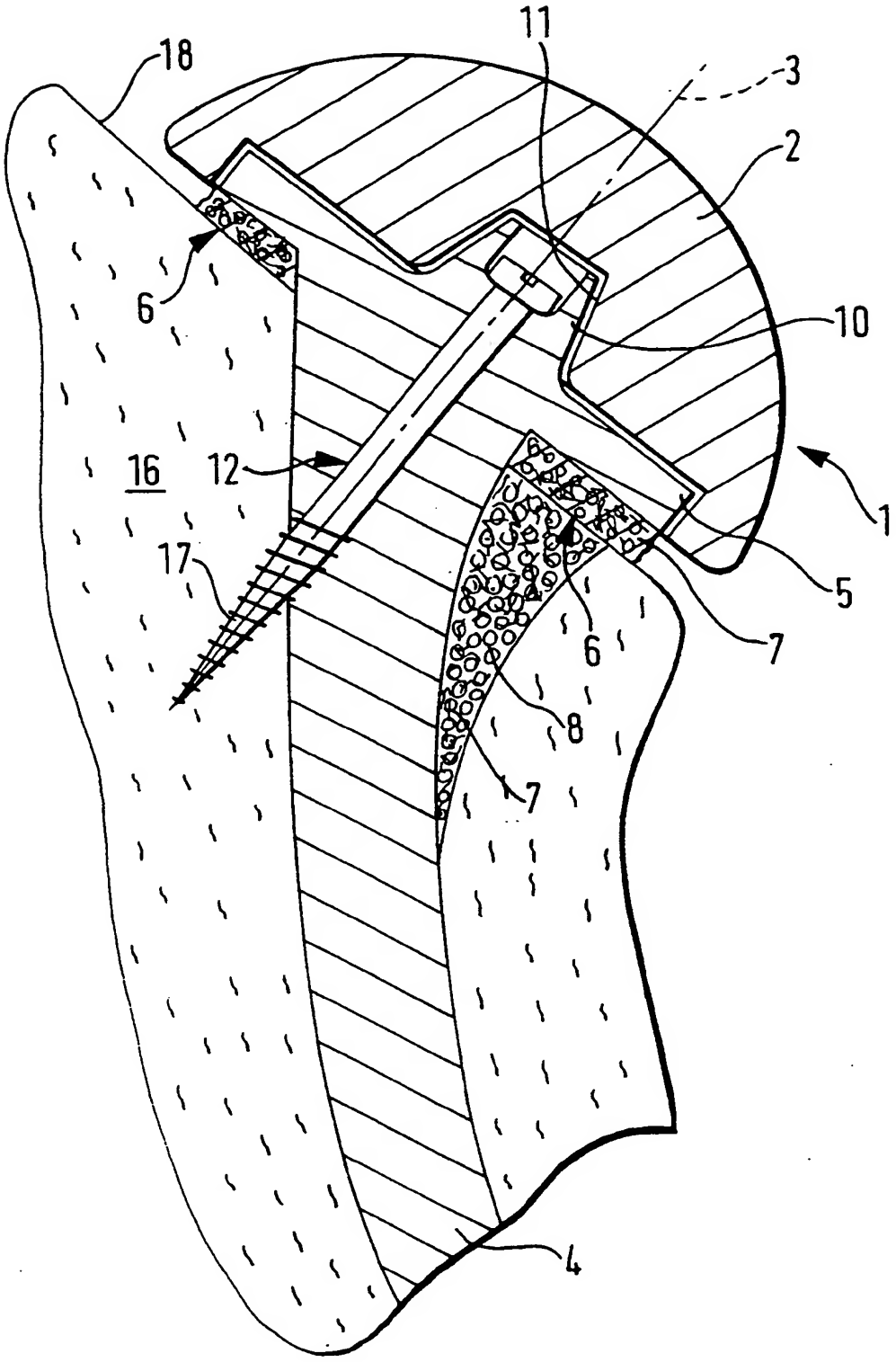

FIG.1

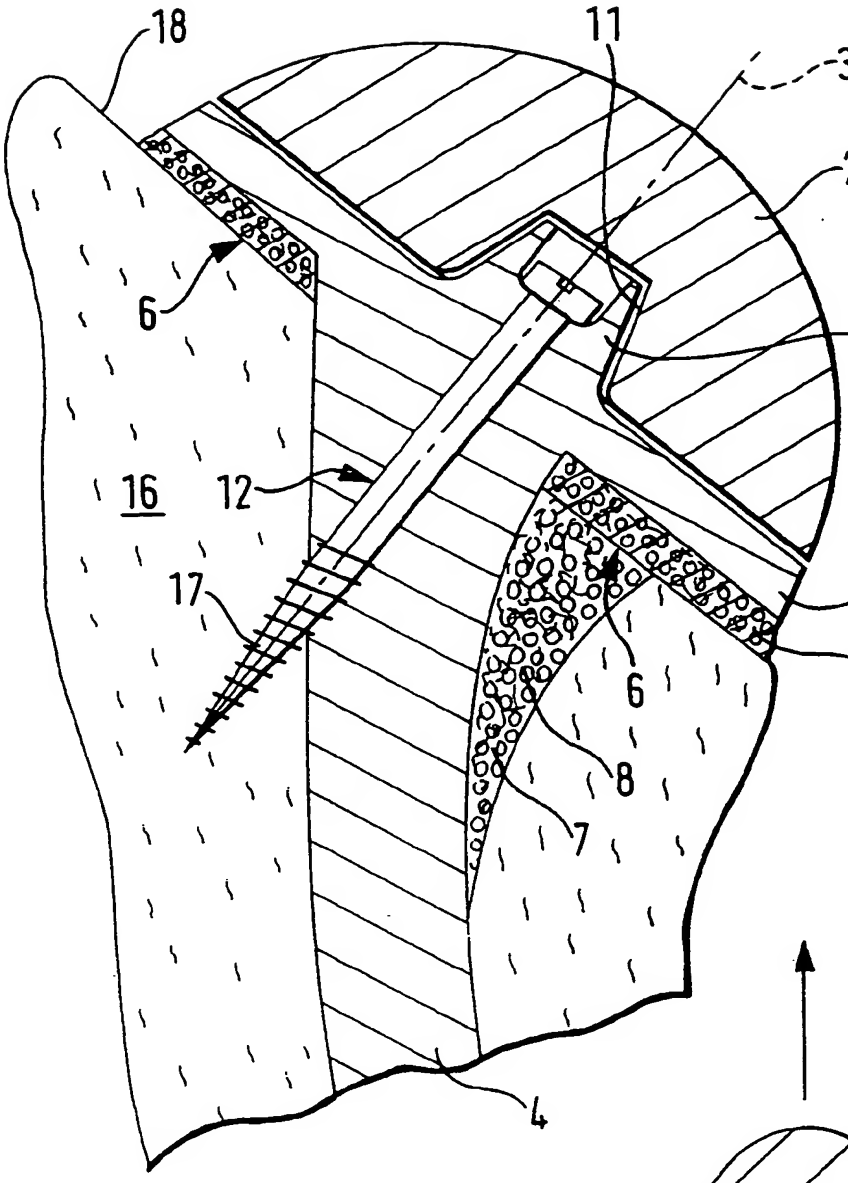

FIG. 2

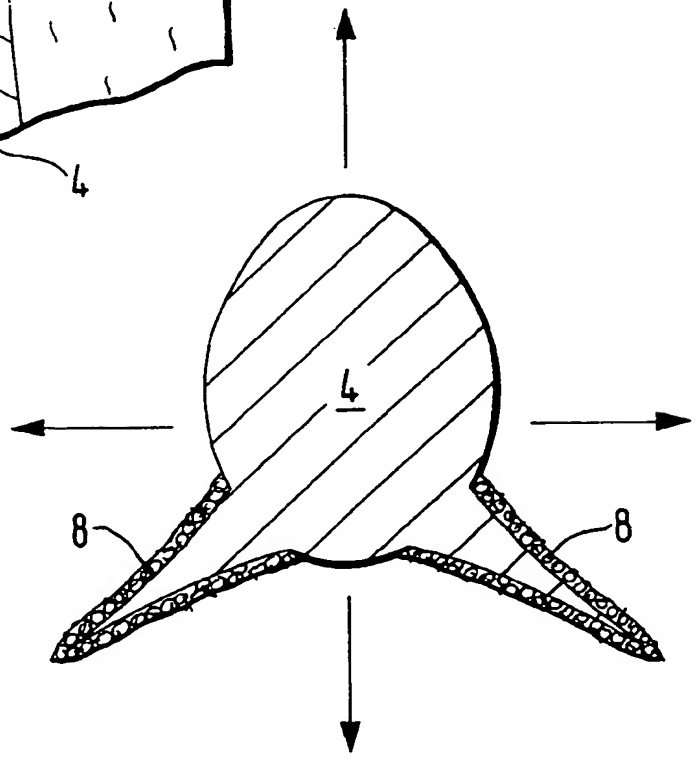

FIG. 3

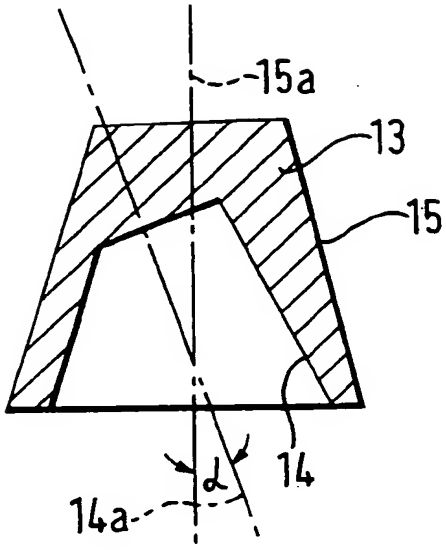

FIG. 4

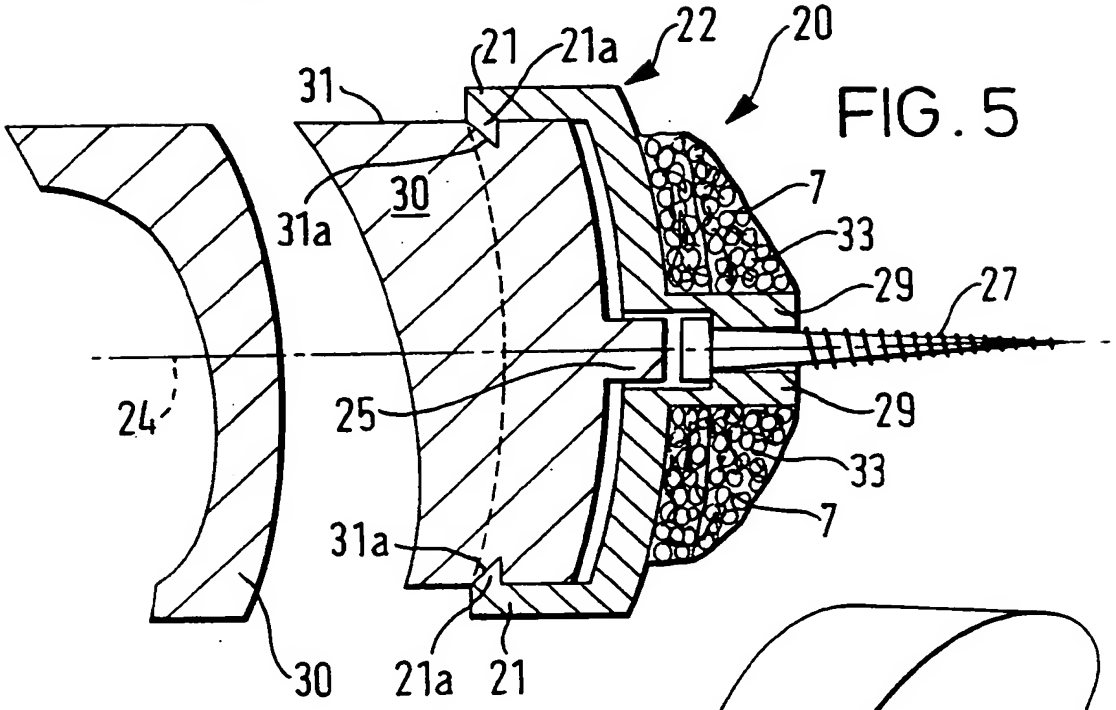

FIG. 5

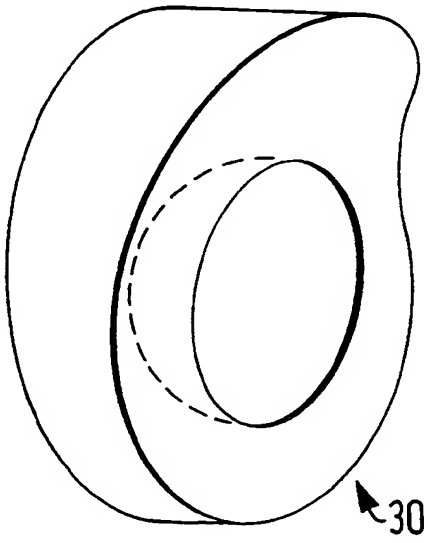

FIG. 6

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(54) Shoulder endoprosthesis

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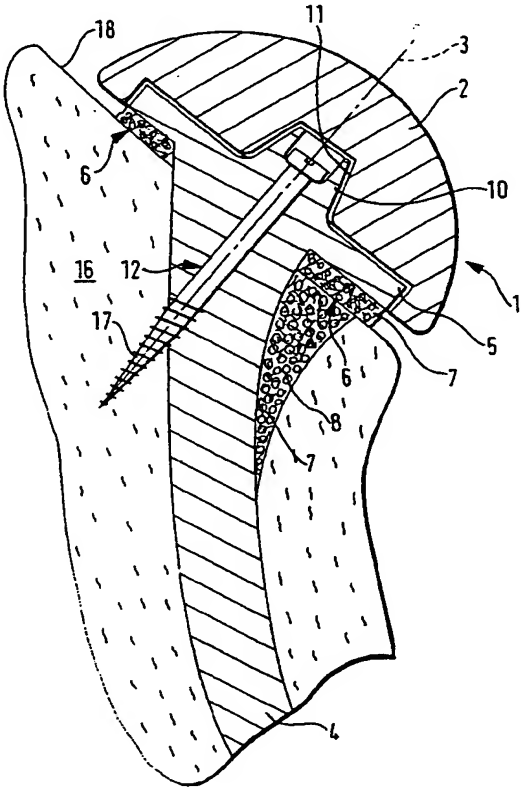

FIG.1

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EUROPEAN SEARCH REPORT

Application Number
EP 95 20 0164

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
Y A	FR-A-2 664 809 (OMCI) * the whole document *	1,5-9,12 13,17	A61F2/40 A61F2/30
Y A	DE-A-42 20 217 (S + G IMPLANTS) * abstract; claim 1; figure *	1,5-9,12 14,17,18	
Y	FR-A-2 579 454 (RAMBERT) * page 5, line 21 - line 28; claims 1,14; figure 2 *	17,19	
Y A	EP-A-0 342 421 (S + G IMPLANTS) * abstract; claims 1,2; figures *	17,19 1,14,18	
A	EP-A-0 549 480 (ÉTABLISSEMENTS TORNIER) * column 3, line 14 - line 27 * * column 3, line 53 - column 4, line 5; figures 1,6,7 *	1,5,12,13	
A	FR-A-2 631 544 (CUILLERON) * claim 6; figures *	2-4,9	
A	EP-A-0 457 222 (INTRAPLANT) * abstract; figures 1,3,5,7 *	9,11	TECHNICAL FIELDS SEARCHED (Int.Cl.6) A61F
A	US-A-4 986 833 (WORLAND) * column 4, line 7 - line 16; claim 1; figures 1-3,5,6 *	13,15,17	
A	US-A-3 869 730 (SKOBEL) * column 2, line 49 - line 61; figure 4 *	18	
A	US-A-4 919 670 (DALE)		
D,A	EP-A-0 329 854 (DINES)		

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	31 January 1996	Klein, C

CATEGORY OF CITED DOCUMENTS

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